# Energy use in the animal feed sector

- Survey analysis representing 70% of the UK animal feed industry
- Compare your mill's performance with the rest of the industry
- Manage your energy use and improve profits

UKASTA
A FORCE IN FOOD AND FARMING



ENERGY EFFICIENCY
BEST PRACTICE PROGRAMME

ENERGY CONSUMPTION GUIDE 80

# ABOUT THIS GUIDE

## PURPOSE OF THE GUIDE

Energy costs represent a significant proportion of overall costs for animal feed mills. Reducing the amount of energy you use will help to increase your profits. Many energy-saving measures can be achieved at little or no extra cost.

This Guide shows the range of energy consumed by animal feed mills, allowing you to compare your costs with those across the rest of the industry. By using the Guide you will be able to:

- compare your energy consumption with industry benchmarks;
- calculate how much energy you use per tonne of finished product;
- identify energy efficiency measures to reduce your energy costs.

## THE SURVEY

The survey was carried out in association with the trade association for the industry, United Kingdom Agricultural Supply Trade Association Limited (UKASTA). It gathered detailed information on energy use, the mix of fuels used, mix of feed type produced and, where possible, information on the processes involved at each mill.

UKASTA's involvement helped ensure a high level of good quality responses. In total, 88 detailed questionnaires were analysed. Based on production, these responses represent 70% of the industry which is sufficient to be confident that the average figures calculated from the data are representative of the whole industry.

The completed questionnaires were independently analysed to compile the necessary benchmark information.

## BACKGROUND

Over ten million tonnes of animal feed are produced annually by the sector.

The total energy use by feed mills in the UK is 957 million kWh/year costing around £24 million/year.

The amount of energy used is equivalent to an annual emission of over 350,000 tonnes of carbon dioxide, the most significant 'greenhouse gas'.

Fig 1 shows the split of energy use within the industry. Electricity accounts for half of the total energy used within the industry although many mills use oil. The geographical location of feed mills often dictates the fuel choice as many sites do not have an available gas supply.

*Silos and conveying equipment*

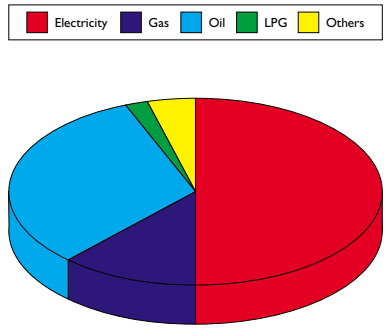


***Fig 1 Analysis of energy type used within the animal feed sector***

Fig 2 shows the split in terms of expenditure. Data compiled from the industry survey revealed that the cost of electricity represented 80% of total energy expenditure, highlighting its comparatively high price. Feed mills generally paid a rate of 3 - 4p/kWh for electricity although the survey found that as much as 10p/kWh was being paid. Typical rates paid for natural gas and oil were found to be 0.5 - 2p/kWh.

This survey was conducted in early 2000 on behalf of the Energy Efficiency Best Practice programme by:
Linden Consulting Partnership. Tel: 01799 524328





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## BACKGROUND

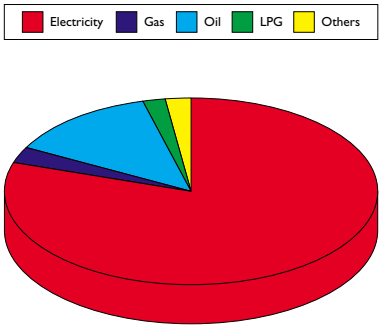


*Fig 2 Analysis of energy costs within the animal feed sector*

*Grinding machine*

### THE ENERGY SURVEY RESULTS

It is useful to have a means of measuring your performance either over time, or against others in the same position. Specific energy consumption (SEC) is a measure of how much energy is used to make one unit of product. This Guide shows you how to calculate your own SEC and benchmark your performance against the average for the industry, calculated using data obtained from the energy survey.

The SEC data has been illustrated as follows:

- Fig 3 shows a best fit line of annual energy consumption for all the 88 sites surveyed, representing about 70% of the industry in tonnage terms. Individual data points are not shown, in order to protect the confidentiality of participating sites. The green area indicates better than average performance and the red area indicates worse than average performance.
- To use the graph to assess your own performance, first calculate your site SEC using the Energy Calculator provided in this Guide (page 6) and plot the point on the graph.
- All types of animal feed production by UKASTA members are represented on Fig 3. Of the total 88 sites, nine produced meal product only without the energy intensive pelletising step. Analysis of the data for the meal only sites showed a reduction in average energy use of 12%. If your site produces mainly or exclusively meal product, you should therefore expect an SEC significantly lower than those presented on Fig 3.
- Fig 3 is a good linear approximation of the relationship between output and energy consumption. Specific energy consumption can vary depending upon the level of production for a particular site. Figs 5 to 8 on page 5 allow you to compare your energy performance with that of other mills of similar size in the industry.

Even if you lie in the green area of Fig 3, energy savings will still be available

If your mill's SEC lies on the right-hand side of Fig 4, or is off the chart altogether, there will probably be many energy savings opportunities. These are summarised in the checklist at the end of the Guide.

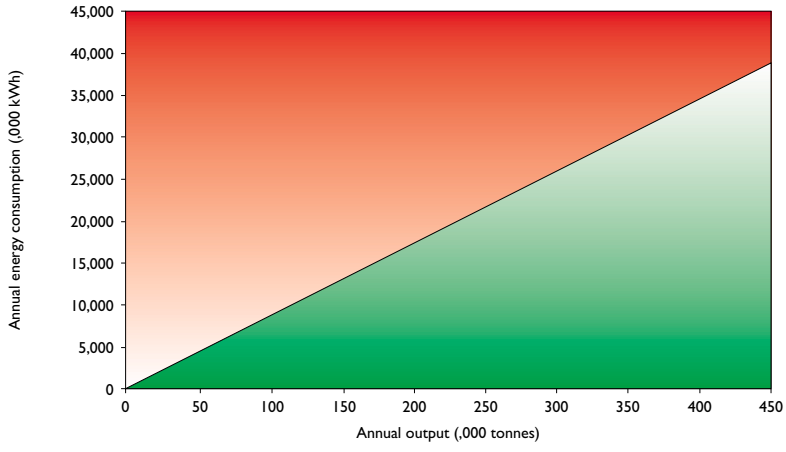


*Fig 3 Industry-wide average annual energy consumption*



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# IMPORTANT CONCLUSIONS FROM THE SURVEY

## KEY POINTS

- The survey results show that there is a wide range of specific energy consumptions across the industry (fig 4) indicating that potential exists to improve energy performance.
- The average SEC for the industry is 83 kWh/tonne.
- The production of pelletised feed requires a greater energy input than the production of meal feed.
- Few mills have implemented a formal energy management policy.
- The majority of mills recognise that potential for energy savings exists.

## SAVE ENERGY, SAVE MONEY

Tackling energy efficiency can improve your competitiveness as the money you save goes straight to profits. It is often more attractive to cut your energy bills than to try to win new business. The following example demonstrates the savings that can be made by improving the energy efficiency of your mill.

A mill produces 100,000 tonnes of feed annually, consuming 10 million kWh of energy at a cost of £350,000/year. The mill's SEC is 100 kWh/tonne (total energy use divided by total output). If the mill reduced its SEC to the average for the industry (i.e. 83 kWh/tonne) while retaining the same output, then 1.7 million kWh of energy would be saved giving annual financial savings of £59,500* or 17%.

*The financial savings shown assume the split of energy costs given in Fig 2.

This hypothetical case serves only as an indication of the potential savings that exist. Some mills, constrained for example by poor process design, may be unable to reduce their energy use significantly without capital investment. Nevertheless, it should be noted that a saving of £59,500/year equates to an increase in sales worth nearly £1.5 million/year for mills operating at a profit margin of 4%.

## SINGLE OR DOUBLE PELLETISING?

The electricity used in most feed mills is substantially increased when the product is double pelletised. This involves passing the ground, heated feed through two pelleting press machines. Approximately one quarter of pelletised production is estimated to be produced by a double process. The drive motor for a pelletising press is typically rated between 150 and 200 kW and double pelletising therefore significantly increases the energy input per unit of product produced.

For a single line, the difference in annual energy consumption may be as much as 200,000 - 400,000 kWh or between £6,000 - £16,000/year. Many mills produce feed pellets on a single press basis, but double pelletising is often used to affect the properties of the finished product.

If an acceptable product quality can be achieved without double pressing, then this change should be seriously considered as a contribution to achieving improvements in mill energy efficiency. Additional benefits may be gained in increasing the throughput of the mill without major capital investment, by freeing a pelletising unit.

*'Box Type' feed cooler*

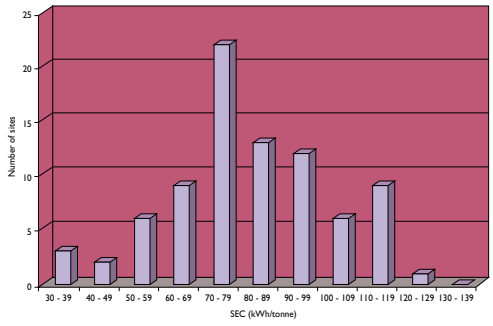


*Fig 4 Industry-wide distribution of SECs by site*





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## IMPORTANT CONCLUSIONS FROM THE SURVEY

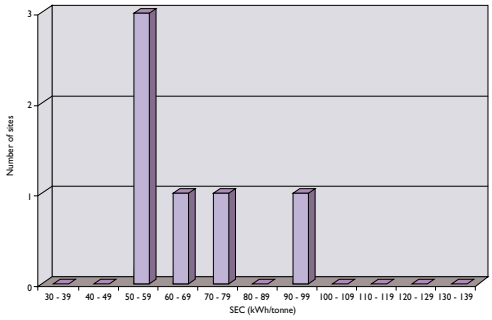



*Fig 5 SEC distribution where total energy consumption < 20,000 kWh/year*

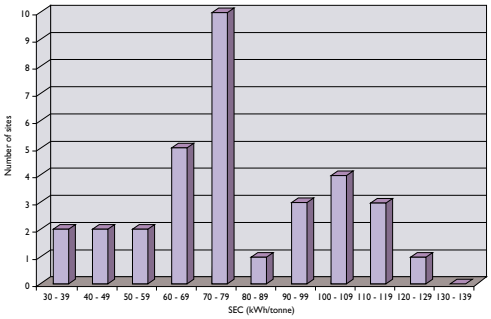



*Fig 6 SEC distribution where total energy consumption = 20,000 - 80,000 kWh/year*

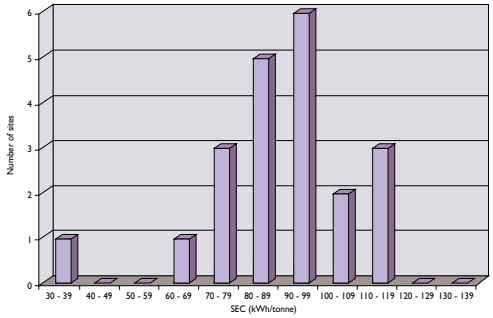



*Fig 7 SEC distribution where total energy consumption = 80,000 - 120,000 kWh/year*

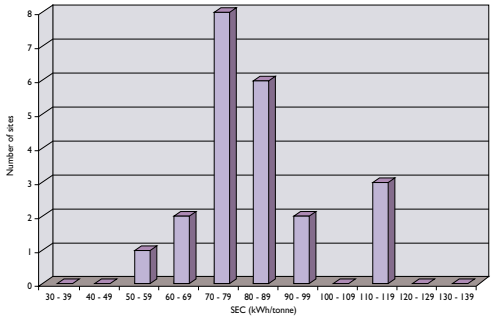



*Fig 8 SEC distribution where total energy consumption = >120,000 kWh/year*

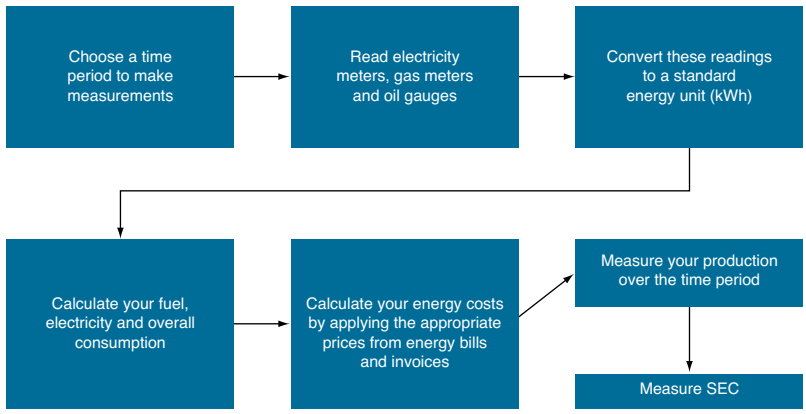

*Transport unloading*

### NEXT STEPS

If you have not done so already, it is recommended that you start measuring how much energy you use, where you use it, and how much it costs. Having this information will help you identify energy efficiency opportunities and enable you to set targets for improvement.

To manage your energy use and expenditure, you need to know how much energy is being used to carry out your process and service requirements. The procedure for calculating overall energy consumption is straightforward. Use the chart below and the simple converter shown overleaf to help calculate your energy use.

*'Calculating energy use' flowchart*



# ENERGY MANAGEMENT

## CALCULATING ENERGY USE SET TARGETS

Your SEC will determine how well you compare with the rest of the industry. Obviously, if your energy performance is a lot worse than the average you can set a large target, as many 'easy' energy-saving initiatives will probably be available. If your performance is already much better than the average then you will probably want to set a smaller but equally challenging target. You will need to identify which operations and services are the major energy users in order to plan energy-saving activities. A summary of recommendations is provided at the back of this Guide to help in the identification of energy-saving opportunities.

*Interior mill lighting*

Make a note of your SEC and check your performance again in three months' time, after you have implemented further energy-saving activities.

## INVOLVE YOUR STAFF

To save energy you need to get people's support. This requires good management. A good first step is to appoint a responsible member of staff to become the site's energy manager or 'champion'. As a guideline, for every £1 million spent on energy an organisation should have one dedicated full-time energy manager. In multi-site organisations it is important for someone to have responsibility at a local level.

Motivating staff is an important part of establishing an effective energy management campaign. Staff awareness of energy efficiency can be improved by implementing some of the initiatives set out in *Managing and motivating staff to save energy* (GPG 84) - a free publication from the Government's Energy Efficiency Best Practice programme available from the Helpline (see back page).

## GOOD HOUSEKEEPING

Make sure that simple activities, like switching off lights, switching off plant and machinery when not in use, and fixing compressed air and steam leaks, are carried out by all staff. This is one of the most effective ways to reduce costs.

## KEEP THE MOMENTUM GOING

Review the results of your energy saving campaign and then set further targets and plan new initiatives.

## CALCULATING ENERGY USE

**Energy Use Calculator**

| | From | | To |
|---|---|---|---|
| | | | |
| Total output during time period (tonnes) | | | |
| | Energy used over period | Conversion factor (multiply by) | Energy used (k/Wh) |
| Electricity (Total) | **kWh** | 1 | |
| Gas Oil (35 sec) | **Litres** | 10.6 | |
| Medium or Heavy Fuel Oil (290 sec and 950 sec) | **Litres** | 11.3 | |
| Gas | **Therms** | 29.3 | |
| Coal | **Tonnes** | 7,350 | |
| LPG | **Tonnes** | 13,778 | |
| **TOTAL** | | | |
| Dividing total kWh by total tonnes of production during the same time period gives specific energy consumption (kWh/tonne) | | | |

# ACTION PLAN & TECHNICAL ISSUES

## ADDRESSING ENERGY USE

The monitoring and targeting system described in this Guide costs virtually nothing to set up and involves little in terms of manpower. You should now consider the types of action needed in order to address energy use, realise targets and maintain momentum. You should start by implementing some measures which are low cost and ensure repayment in a comparatively short time. It would also be useful to formulate an equipment management policy so that when existing equipment fails an appropriate replacement can be purchased.

## IMPROVING ENERGY EFFICIENCY

Some technical measures are explained below and summarised on the checklist overleaf. Further information is available from the Energy Efficiency Best Practice Programme (see back page for contact information).

The Food and Drink "Essentials" Publication list, will signpost you to the key publications across a range of energy saving areas including those listed below. Copies are available free from the Environment and Energy Helpline, tel 0800 585794. Alternatively, publications can be ordered through the website, www.energy-efficiency.gov.uk

## MOTORS AND DRIVES

Larger motors are commonly used on presses (extruders) and grinders which operate for extended periods of time and hence are a major energy user in feed mills. Small capacity motors, used extensively for conveying and elevating, also have a large combined power consumption.

The three principal areas for energy saving are:

- increased use of high efficiency motors where financially justified;
- use of variable speed drives on motors which satisfy varying demands;
- reduced run-time by paying attention to shutting down process equipment when not required.

A motor management policy is an effective method of ensuring that repair/replacement decisions are made correctly, and often motor suppliers can help to establish such systems.

## STEAM GENERATION AND DISTRIBUTION

Steam is raised for inclusion into the mix to condition it prior to pelletising and as a heating medium for fat storage. Some mills also raise steam for use in biological separation processes.

The steam boiler typically accounts for over half the energy input into a feed mill and so an improvement in its efficiency will result in cost savings. Improved boiler maintenance along with combustion efficiency tests by a qualified contractor will identify any controllable heat losses. Even a 1% increase in boiler efficiency would result in significant savings.

The steam distribution system has three principal areas for energy saving:

- increased use of insulation on all distribution pipework including valves and flanges;
- improved steam leak detection and repair;
- improved operation of steam traps to recover clean condensate.

## COMPRESSED AIR

Compressed air is commonly used for actuators for doors from raw material bins, mixer discharge, packaging machinery and with compressed air tools for maintenance.

Air leakage from several items of plant can be a persistent source of wasted energy. Compressed air is an expensive resource (equivalent to 50p/kWh) and therefore leaks should be identified and repaired quickly. By recording compressed air use during a period of zero production, it will be possible to measure the amount of compressed air being wasted.

It is much more efficient to compress cold air than warm. Consideration should therefore be given to the location of air compressors to ensure that cold air is ducted to the air inlets of the compressor.

## LIGHTING

The main opportunity for cost and energy saving in the area of lighting is through the replacement of old T12 (35 mm diameter) fluorescent tubes on failure with T8 tubes (26 mm diameter) which are five times more efficient. T5 tubes are the latest range and are even more efficient.

Other energy-saving opportunities include:

- replacing tungsten filament bulbs with fluorescent lamps;
- fitting photocell control to lighting in loading bay areas;
- consideration of occupancy sensors to control lighting in areas of the mill that are rarely visited;
- installation of high frequency controls when refurbishing lighting systems.



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# ACTION PLAN

## SUMMARY

The key energy-saving areas identified in this Guide are summarised in the list below. An indication of the cost and payback period of potential energy-saving initiatives has been included. Also included is a guide to the scope of the recommendations, i.e. to what extent these recommendations apply to the industry. The checklist is intended to act as an aid to managers responsible for energy who are devoting effort into reducing energy consumption and costs.

| Measure | Low/Medium/ High Cost | Payback Period | Scope |
|---|---|---|---|
| Ensure process plant and associated services are switched off when not required | No cost | Immediate | 100% |
| Use high efficiency motors, especially in place of re-winding | Low/medium cost | 2 - 3 yrs | 100% |
| Consider use of variable speed drives in appropriate applications such as cooler fans | Low/medium cost | 18 mths - 5 yrs (further study required) | 100% |
| Investigate the cost benefits of improved boiler maintenance together with combustion efficiency tests | Low cost | 6 mths - 1 yr | 100% |
| Check steam trap operation to ensure all clean condensate is returned to the boiler hotwell | Maintenance | Immediate | 40% |
| Check steam pipe, flange and valve insulation and renew where missing or damaged | Maintenance | 1 - 2 yrs | 95% |
| Check plant for compressed air leaks especially where unions join pipes to air hoses | Maintenance | Immediate | 100% |
| Replace T12 fluorescent tubes with T8s on failure and consider use of T5s | No cost | Immediate | 100% |
| Consider high frequency fluorescent lighting controls when refurbishing lighting systems | Low/medium cost | 18 months - 2 yrs | 95% |
| Install photocell control to bulk loading bay fluorescent lights | Low cost | 6 mths | 20% |